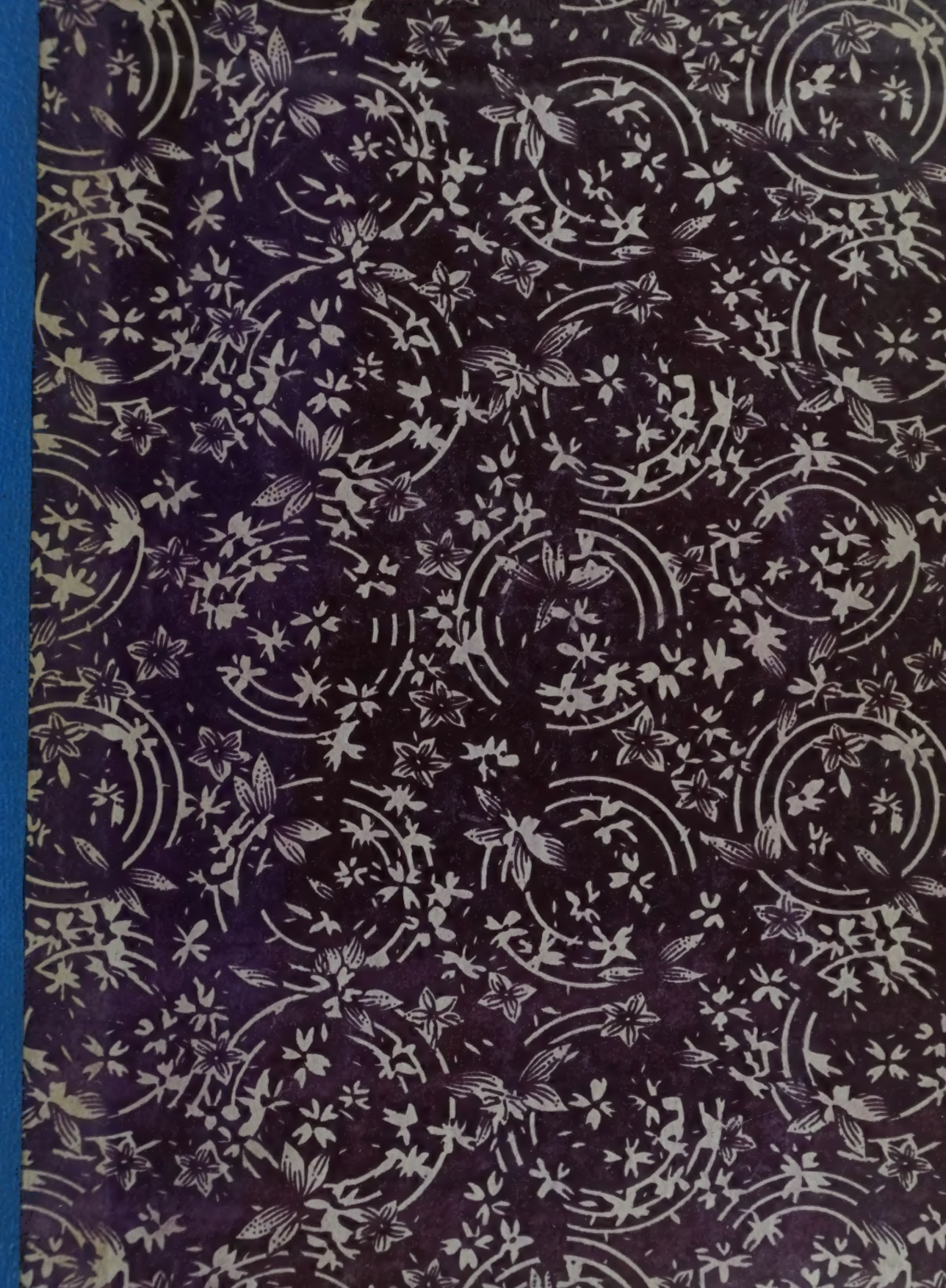

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May 1973

APPLICATION OF REVERSE OSMOSIS TO FOOD PROCESSING

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See also back page

1 E 7
Reverse osmosis ... engineering considerations.
Besik, F.; Zarnett, G.; Pancuska, V
Mlynarczyk, A.
Food Engineering 43 (7) 72-75 (1971) [4 ref. En] [Ontario Res. Foundation, Sheridan Park, Ontario, Canada]

Reverse osmosis in combination with spray-drying offers an economic method of processing whey into powder, even though the degree of concn. of whey is limited at 25-30% TS due to crystallization of lactose. Details are given of a preliminary engineering design of a compact unit for processing cheese whey into powder, and data indicating the economics of such a process are tabulated. AB

1 E 40
Food applications for membrane ultrafiltration.
Porter, M. C.; Michaels, A. S.
Food Product Development 5 (1) 64 & 66-67 (1971) [24 ref. En] [Amicon Corp., Lexington, Massachusetts, USA]

Low pressure membrane filtration can be economically used to dewater and/or demineralize aqueous food products. It can remove up to 90% of the water at selected temp. over the range 4-100°C, thereby avoiding thermal, oxidative, and pH damage and also changes in the ionic strength of the product during processing as salts are freely permeable. The application of membrane ultrafiltration in the processing of dairy produce, particularly separation of protein and lactose from whey, egg whites, meat produce, fruit and vegetable extracts, fish protein concentrates, single cell proteins and in batch fermentations are outlined. AH

1 G 7
[Technology of food concentrates production.]
Technologia koncentratow spozywczych. [A book]
Pazola, Z.; Piekarz, J.; Prominski, W.; Swierczynski, A.; Waczynski, R.; Wojtkowiak, S.
341pp. (1970) [Numerous ref. Pl] Warsaw, Poland: Wydawnictwo Naukovo-techniczne. Price 54 zl.

Descriptions are given of production processes for individual types of food concentrates, raw materials used and machinery and equipment. The 1st part deals with general principles of food concn., especially main food drying techniques including modern methods. The other parts deal with individual groups of food concentrates including baby food, special vitamin concentrate and coffee concentrates STI

1 H 135
[Concentration of grape juices by ultrafiltration.]
Kishkovskii, Z. L.; Mekhuzla, N. A.; Belov, N. I.
Sadovodstvo, Vinogradarstvo i Vinodelie Moldavii 26 (2) 34-37 (1971) [Ru] [Moskovskii Tekhnologicheskii Inst. Pishchevoi Promyshlennosti, USSR]

The concn. of grape juices is almost exclusively done by evaporation or freeze-drying, but these methods tend to deteriorate the juices. A new method of ultrafiltration is based on water penetration of a semipermeable membrane at various pressures. The article deals with ultrafiltration using an acetyl-cellulose membrane prepared at temp. from 70-90°C. The procedure for making the membranes and a scheme for the filtering apparatus are given. Filtering velocity depends on the thermal treatment of the membrane. Chromatograms of the initial raw material and the filtrate are compared. Experiments on wine filtering showed that at a pressure of 100 atm. a considerable quantity of alcohol passes through the semi-permeable membrane (out of 10.2% alcohol in the original material the filtrate contained 9%). This concn. method leads only to minimal losses of aroma. STI

1 P 80
Membrane processing a new tool for whey disposal.
McDonough, F. E.
Dairy Industries 36 (9) 507-509 (1971) [6 ref. En, fr, de, cs] [E. Marketing & Nutr. Res. Div., USDA, Beltsville, Maryland 20705, USA]

This is a short review of 2 related membrane processes, reverse osmosis and ultra filtration, and their applications in concentrating and fractionating whey, respectively. The limitations of these processes are mainly economic, involving the reliability and life of the membranes. SAC

2 E 70
Reverse osmosis - a multi-use filtration phenomenon.
Goodall, H.
Food Technology in Australia 23 (9) 464-465 (1971) [4 ref. En] [British Food Manufacturing Ind. Res. Assoc., Leatherhead, Surrey, UK]

2 L 189
Experimental results obtained in decolorizing and desalting dilute molasses solutions with Permasep ultra filtration modules.
Bichsel, S. E.; Levad, J. A.
Journal of the American Society of Sugar Beet Technologists 16 (3) 197-206 (1970) [9 ref. En] [Holly Sugar Corp., Colorado Springs, Colorado, USA]

Ultrafiltration purification of dilute molasses solutions was studied with Du Pont "Permasep" hollow nylon fibre membranes (4 in × 7 in Permeators with selectivities of 3-19% salt passage (SPE)). The flow scheme (illustrated) recycled permeate, reject and bleed to the feed tank to ensure constant feed composition. Details are given of colour reduction, of removal of non-sugars, N in various forms, invert sugar, raffinose and kestose and of salt removal by one-stage treatment with a 19% SPE module and 3-stage purification with 7 or 8% SPE modules. During 10 days continuous operation, permeate flows decreased by 30-40% for low PSE and 50-80% for high SPE permeators, and could only be partially relieved by cleaning with various agents. It is considered that the process is not yet economic due to initial cost, inadequate capacity, loss of capacity and poor service life of the permeator. RM

2 P 201
Applications of reverse osmosis/ultrafiltration in the dairy industry.
Donnelly, J. K.
Farm and Food Research 2 (5) 113-115 (1971) [En] [Nat. Dairy Res. Centre, Tech. Dept., Moorepark, R. of Ireland]

Reverse osmosis and ultrafiltration are described. Applications discussed include

concentration of whey, skim-milk and whole milk, and fractionation of whey into protein-rich and lactose-rich streams. AJDW

3 P 294

Protein concentrate from cheese whey by ultrafiltration.

McDonough, F. E.; Mattingly, W. A.; Vestal, J. H.

Journal of Dairy Science 54 (10) 1406-1409 (1971) [14 ref. En] [Dairy Products Lab., E. Marketing and Nutr. Res. Div., USDA Washington, DC 20250, USA]

Concentrates containing up to 65% protein in the solids were recovered from cheese whey using tabular cellulose acetate ultrafiltration membranes designed to retain solutes >20 000 mol. wt. Removal of 90% of the water as permeate, at an average rate of 12 gal/ft² membrane surface/day, resulted in a concentrate containing 20% solids with 35-37% protein and 50-52% lactose. By diluting 1:9 with water and recycling for a second time to 90% reduction in vol., a concentrate containing 60-65% protein and 30-35% lactose in the solids was obtained. Protein, lactose + lactic acid and ash retentions by the membrane were 97-98%, ~22% and 4-5%, respectively. The membranes operated for >300 h at 14 kg/cm² with no sign of deterioration. SAC

3 P 308

Dairy science section 2nd annual conference. Abstracts of papers.

New Zealand Society of Dairy Science and Technology

New Zealand Journal of Dairy Science and Technology 6 (3) 122-127 (1971) [4 ref. En]

The following papers were presented at the Conference held in Palmerston North on 16 June 1971: Ultrafiltration: fluid mechanics and mass transfer, by K. J. Kirkpatrick (p. 122); Casein micelle structure - a review, by L. K. Creamer (pp. 122-123, 1 ref.); The nature of protein materials adsorbed to the fat-serum interface of homogenized milk, by R. M. Fenwick (p. 123); Immunoglobulin and carotenoids in colostrum, by D. F. Newstead (pp. 123-124); Seasonal variations in the total, non-protein, and urea nitrogen contents of Friesian and Jersey milk, by A. K. R. McDowell (p. 124); The influence of the bacterial flora of milk on the methylene blue reductase test, by T. F. Fryer (pp. 124-125); Variations in bacteriophage host range, by R. J. Lowrie (p. 125); Starters for 'fancy' cheese manufacture, by W. M. Legg (p. 125); Winter storage of milk powder in the Waikato district, by D. L. Pooch & T. L. Choat (pp. 125-126); Moisture uptake by milk powders, by R. J. Hubbard (p. 126); High rate biological oxidation of dairy w
126-127); Milko-tester Mk III and Pro-milk Mk II as production controllers, by J. B. R. Walker (p. 127, 3 ref.); and A comparison of the melting behaviour of the high melting glyceride portion of milkfat in bulk and in artificial globules, by J. W. Sherbon & R. M. Dolby. [See FSTA (1971) 3 6P883 for report of previous conference.] CDA

3 P 343

[The cheese factory of tomorrow.]

Anon. (Casilis, J.; Pien, J.; Cherrey, J.; Alais, C.; Tschieret, J.-X.; Blanchet, M.; Blezat, J.; Vergnet, M.; Lempereur, F.; Fradin, M.; Reichel, A.; Jacquemet, J.-C.)

Technique Laitiere 1971 (719) 156 pp. (1971) [Fr]

This special issue includes the following articles: Orientation of research on cheese manufacture, by J. Casilis (pp. 37-43); Sterilization of milk in the cheese factory, by J. Pien (pp. 49-55); Use of dried milk in cheesemaking, by G. Cherrey (pp. 57-61); Milk coagulating enzymes, by C. Alais (pp. 63-65, 6 ref.); New techniques and continuous processes in the cheese factory of tomorrow, by J.-X. Tschieret (pp. 67-73); Coagulation in turbulent conditions, process S. T., by M. Blanchet (pp. 75-77, 7 ref.); Mechanization of whey drainage and curd moulding, by J. Blezat & M. Vergnet (pp. 85-88); Ripening cheese without microorganisms, by J. Pien (pp. 91-93); Manufacture of rindless cheese, by F. Lempereur & M. Fradin (pp. 95-97); Problems of road transport in the distribution of perishable foods, by A. Reichel (pp. 103-106); Recovery of proteins lost in the whey, by J. Pien (pp. 109-111); and Electrodialysis, reverse osmosis and ultrafiltration for the treatment of whey, by J.-C. Jacquemet (pp. 113-115). FL

3 P 399

Reverse osmosis in processing whey.

Besik, F.

Canadian Food Industries 42 (7) 32-35 (1971) [20 ref. En] [Dept. of Eng., Res. Foundation, Ontario, Canada]

Only 40% of the 128 cheese factories in Ontario have acceptable whey disposal practices; this article discusses possible applications of reverse osmosis, a process using semi-permeable membranes to concentrate high mol. wt. compounds by separating off water and other small molecules, and reports on some experimental studies using Havens Osmotic module 18 tube series, with turbulence promoters, Mk III and solutions of different concn. of dried cheese whey. Concn. of organic and inorganic material in the water permeate increased with increasing whey concn. and decreasing operating pressures. With high (HR) and low rejection (LR) membranes, ~99+ organic material is retained in both cases; less inorganic material is retained by the LR membrane, loss of inorganic material being 52% if concentrating whey from 6 to 25% solids compared with only 10% with HR membranes operating at 800 lb/in². Flux rate of the permeate decreased linearly with increasing concn. of whey for both HR and LR membranes and increased with pressure and coarseness of the membrane. On comparing the 2 membranes, average flux rate w comparing the 2 membranes, average flux rate wa ~33% higher for the LR membrane, which coupled with its potential to reduce salt content in whey ~50%, makes it economically more attractive than the denser HR membrane. The permeate can be treated either biologically to reduce organic material to an acceptable level or using activated carbon adsorption for re-use as clean water. Calculations for a preliminary engineering design of a compact unit for processing cheese whey are included. SAC

3 P 401

Whey powder.

Keay, J.

Food Manufacture 46 (11) 36, 41 & 43 (19 1) [En]

[Agric., Fisheries and Food Products Branch, Dept. of Ind., Trade and Commerce, Canada]

The following aspects of whey processing are covered: problems of whey drying; concentration and fractionation of whey by reverse osmosis; and ultrafiltration. Applications of whey in food processing are discussed; a table of examples of the use of whey in foods includes baked goods, dry mixes, ice cream, sherbet, confectionery, icings, frostings, jams, apple butter, ice lollies, batter mix, whey-soya beverage (citrus flavour and sterilized), processed cheese, and whey-soya blends for food manufacture. AB

3 P 423

[Preparation of cheese from a concentrate obtained by ultrafiltration of milk.]

Maubois, J. L.; Mocquot, G.; Thapon, J. L Humilier, M.-C.; Chopin, A.; Goudedranche, H.; Dupas, C.; Blanc-Patin, E.; Piot, M.; Fauquant, J.

Lait 51 (508) 495-533 (1971) [42 ref. Fr, en] [Lab. de Recherches de Technol. Laitiere, INRA, 65 rue de Saint-Brieuc, 35 Rennes, France]

Skim-milk, concentrated to a liquid product containing 5-6 times more protein, using ultrafiltration membranes with suitable time/temp. combinations, had a similar composition using low (~2-4 C) or high (~50 C) treatment temp. High fat cream added to this product + starter + rennet (~1/5th usual strength) produced a soft cheese with similar organoleptic qualities after ripening to those of cheeses produced in the traditionalway. In an example given, 100 kg skim-milk (8.8% DM, 3.2% protein) resulted in 16.4 kg conc. product (27.1% DM, 19.1% protein) to which 5.5 kg cream (67% fat), 0.4 kg starter, a few mg of penicillium spores and 5.2 ml rennet e tar) o eddgechuhstsfspsule ureo (1:10 000) were added, producing 22.3 kg cheese, losing little whey, and giving 21.0 kg ripened cheese (41% DM, including 31.1% fat). The advantages of this method of soft cheese manufacture include increases in yield (due to retention of milk soluble proteins usually lost in whey), smaller fat and DM manufacture and less whey for disposal. SAC

4 A 168

Nature's filtration process put to practical use.

Goodall, H.

Food Technology in New Zealand 6 (10) 18-20 (1971) [En]

The nature and uses of reverse osmosis are described. Plastics films applicable to reverse osmosis are discussed with special reference to cellulose acetate. IN

4 E 137

Reverse osmosis in food processing. [A symposium]

United States of America, Department of Agriculture,

38pp. (1969) [En] Albany, California, USA: Author

Review-type papers read at this symposium, held in Jan. 1969 in Albany, included the following: Reverse osmosis in food processing - an overview, by R. L. Merson (pp. 1-10); Concentrating egg white, by E. Lowe (pp. 10-16); Concentration of maple syrup, by J.C. Underwood (pp. 16-18); Concentrating and fractionating whey, by W. L. Dunkley (pp. 19-28); Treatment of waste streams from food processing, by W. A. Mercer (pp. 29-32); and Report of informal discussions, by L. F. Ginnette (pp. 32-34). JMD

4 E 138

[Production of fresh water from the sea.] Die Gewinnung von Süsswasser aus dem Meer.

Kunz, G. K.

Kälte-Klima-Praktiker 11 (11) 348-350 & 352-354 (1971) [14 ref. De] [GHH-Man-Technik Gesellschaft für Anlagenbau, Essen, W. Germany]

Water as raw material, research and development of desalination processes, production installations, multi-stage evaporation, steam condensation, electrodialysis, freezing and separation, and reverse osmosis are discussed together with combinations of production of water and energy (waste steam from turbines, waste gas from diesel engines, nuclear energy, and solar energy). OA

4 E 169

Reverse osmosis applications.

Leightell, B.

Chemical and Process Engineering 52 (6) 79-80 (1971) [En] [Ames Crosta Mills, Heywood, Lancs., UK]

The Gulf/Ajax reverse osmosis system, which uses spirally-wound membranes assembled in modular form, is described. Among the applications for reverse osmosis presented are the production of drinking water and of commercial water (non-drinking) for agricultural use. AB

4 E 170

Reverse osmosis - a filtration process.

Goodall, H.

Food Industries of South Africa 24 (2) 20 & 21 (1971) [4 ref. En] [British Food Manufacturing Ind. Res. Assoc., Randalls Rd., Leatherhead, Surrey, UK]

The process of reverse osmosis and membranes employed are described and discussed. Applications in the food industry include: concentration of fruit juices and other beverages such as tea, coffee, meat broth and beer; partial concentration of sap before boiling, in the production of maple syrup; processing of whey from cheese manufacture; and concentration of egg albumen. AB

4 G 193

The food processing front of the seventies.

Bird, K.

Journal of the American Dietetic Association 58 (2) 103-108 (1971) [7 ref. En] [Util. Economics Res. Group, Marketing Economics Div., Economic Res. Service, USDA, Washington, DC, USA]

3 processing changes which may affect the food industry during the seventies are considered: soy proteins, aseptic canning and reverse osmosis. Their advantages, disadvantages, uses and future prospects are discussed. VJG

4 G 215

Sunflower protein product.

O'Connor, D. E. (Procter & Gamble Co.)

United States Patent 3,622,556 (1971) [En]

Process is described for preparing a light-

methods, including brief information on separation efficiency and throughput and on problems in their application. FL

9 E 356

[Engineering and apparatus in the food industry.] Inzynieria i aparatura przemyslu spozywczego. [A book]

Tuszynski, W.; Budny, J.; Kleszczewski, M. 466pp. (1971) [59 ref. Pl] Warsaw, Poland: Wydawnictwa Naukowo-technyczne. Price 43 zl.

This handbook contains the following chapters: Principal dynamic processes; Heating; Heat exchangers; Boiling and concentration processes; Pressure; Sorption; Distillation; Ventilation; Climatization; and Drying, measuring and automation apparatus. STI

9 E 363

[Concentration by reverse osmosis.] [A review]

Novaceanu, M.

Industria Alimentara **21** (2) 94-96 (1970) [10 ref. Ro, en, fr, de, ru] [Inst. de Cercetari Alimentare, Bucharest, Roumania]

Various aspects of concn. using reverse osmosis are reviewed, and illustrated with diagrams, including the preparation of semi-permeable membranes, factors affecting the degree of concn., installations using this method and its possible uses in the food industry. SAC

9 G 445

[Food research at Lund.]

Thome, K. E.

Livsmedelsteknik **12** (4) 186-187 (1970) [Sv]

Food research projects being carried out at the Chemical Centre, University of Lund, Sweden, include: Effect of psychrophilic organisms on foods; Production of biomass for industrial purposes; Efficiency of automatic washing processes; Industrial catering (chemical and physical problems); Determination of colour and texture in starch and protein gels; Mechanism of foam formation; Membrane techniques (fractionation, separation); Structural function of protein in food; Changes in proteins on heating of food; Potential modification of starch from the food technology viewpoint; and Accelerated cheese ripening. HBr

9 J 1496

Downward forced flow evaporator.

Jansen, V. F.

Food Manufacture **47** (3) 33-36 (1972) [En] [H. J. Heinz Co. Ltd., Hayes Park, Hayes, Middlesex, UK]

The design, construction and applications of downward forced flow evaporators are dicussed. Advantages claimed include minimal scale formation, absence of boiling in evaporator tubes, short contact with heating surfaces, low temp. differential across heating tubes, easy cleaning, continuous operation for up to 1 wk, and suitability of concentration of viscous liquids. Application of the evaporators to tomato concentrate manufacture is described; other uses include concentration of milk, orange juice, grape juice and apricot or pear pulp. Commercial models are available in capacities of 3400-32 000 kg of water evaporated/hr. AJDW

9 P 1254

Abstracts of papers to be presented at the sixty-seventh annual meeting, Virginia Polytechnic Institute and State University, Blacksburg, July 26-29, 1972. Manufacturing section. [Chemistry.] United States of America, Dairy Science Association

Journal of Dairy Science **55** (5) 660-661, 668, 672-673 & 678-679 (1972) [En]

Abstracts in this section concerning the composition of dairy products include the following: B-Complex vitamins in yoghurt, by K. P. Reddy & K. M. Shahani (M7); Cheese whey as a food ingredient - its microbial and chemical quality, and storage stability, by R. Singh & D. C. Westhoff (M10); Separation of nitrogenous residues from deproteinated whey for lactose crystallization, by P. Jielen, P. B. Manning & S. T. Coulter (M42); Polyacrylamide disk gel electrophoresis of whey proteins fractionated by ultrafiltration, by D. P. Sinha & E. M. Mikolajcik (M43); Effect of benzoyl peroxide on milk for Blue cheese manufacture by C. J. Washam, G. W. Reinbold, E. R. Vedamuthu & R. Jorgensen (M63); Distribution of added Fe in cows' milk, by J. J. Basch, S. B. Jones, E. B. Kalan & V. Wondolowski (M87); Effect of emulsifiers on stability of milk fat emulsions, by L. M. Smith & T. Dairiki (M88); Effect of fluorescent lights on flavour and vitamins of milk packaged in plastics bottle and method to prevent deterioration, by A. P. Hansen, L. G. Turner & L. W. Aurand (M90); and Determination of lactose in whey protein concentrates, by G. A. Reineccius, P. E. Swenson & R. L. Richter (M91). SAC

9 P 1275

[Manufacture of dried milk of specified heat treatment classification.] Herstellung von Milchpulver mit spezifischer Wärmeklassifikation.

Knipschildt, M. E.

Nordeuropaeisk Mejeri-Tidsskrift **38** (3) 62-64 (1972) [De & Da]

The subject is discussed under the major headings of classification according to heat treatment and solubility, spray-drying, and concentration and pre-heating. In conclusion, the author emphasizes the importance of the manufacture of dried milk with specified heat treatment classification and points out that the serum protein index, although very useful, is not a sufficient criterion for assessing the suitability of dried milk for certain purposes. FL

9 P 1325
['Lactosan', a new dairy food for infants.]
Chintescu, G ; Lefter, D.; Vasiliu, G.
Industria Alimentara **22** (9) 511-513 (1971) [Ro, en, fr, de, ru] [Inst. de Cercetari si Proiectari Alimentare, Bucharest, Roumania]

The experimental production of 'Lactosan' from ilk and changes occurring during concn. to 44-46% TS, homogenization at 100, 150 and 200 atm. at 48-50°C and drying using a NIRO drier are described. This dried milk contains 25-26% fat, 26.15-26.2% protein and 38.66-39.10% lactose, has a solubility of 99.8% and contains 30 000 bacteria/g with no coliforms present. The product gave satisfactory results in clinical trials. SAC

9 P 1329
[New methods for the demineralization of whey.]
Neue Verfahren zur Entmineralisierung von Molke.
Quenouille, J. Y.
Deutsche Milchwirtschaft **23** (2) 34-36; (3) 68-70 (1972) [De] [Societe des Usines Chimiques Rhone-Poulenc, Paris, France]

The subject is discussed with particular reference to electrodialysis, reverse osmosis and ultrafiltration and their applications. The approximate production cost of demineralized (50% reduction) dried whey by electrodialysis in a plant with a throughput of 100 000 l. whey/day, operating 20 h/day for 300 days/yr are given as 9.58 pfennig/kg. Reverse osmosis and ultrafiltration in application to whey concentration are dealt with, and brief data given on plants manufactured by the author's company. FL

9 S 1096
[Selected basic problems in meat science. Water as a meat component.]
Tyszkiewicz, I.; Tyszkiewicz, S.
Gospodarka Miesna **24** (4) 23-27 (1972) [8 ref. Pl]

The mechanisms of water binding in meat, crystallization, hydration of colloidal ionic components, diffusion, solubility capacity, low temp. freezing, osmosis, surface activity, and electrical conductivity are discussed with reference to characterization of meat and effects on protein as the major constituent. Calculation formulae for the effect of water content on the composition of meat are outlined. OA

10 G 505
[Purification of waste waters from the meat and fish industries.] [A review]
Baldacci, P.; Canuti, A.; Coppiardi, G.
Industrie Alimentari **11** (2) 51-58 (1972) [28 ref. It, en]

10 J 1623
Osmotic dehydration.
Hope, G. W.; Vitale, D. G.
1562db **IDRC-004e** 12pp. (1972) [8 ref. En, fr] [Canada Dept. of Agric., Food Res. Inst., Ottawa, Ontario]

About 40% of the water can be removed from certain tropical fruits by a simple process. For bananas and plantains, this involves immersing slices in a concentrated sugar solution for about 18 hours; for ripe mango, it involves the same treatment for about 4 hours; for green mango, it involves immersion in a concentrated salt solution for about 24 hours. The economics of the process probably depend on the availability of cheap sugar and on the possibility of using spent sugar solutions in canning, bottling, or soft-drink plants. Final treatments by drying in the sun or in air currents are suggested, as well as methods of preserving dried fruit with sulphur dioxide. A detailed report is given of experiments carried out in Ottawa together with recipes that could be used in processing plants. AS

10 L 744
[Purification of effluent from the sugar industry.]
[A review]
Canuti, A.; Baldacci, P. V.
Industrie Alimentari **11** (3) 109-116 (1972) [26 ref. It, en]

10 P 1459
Sanitation of reverse osmosis/ultrafiltration equipment.
McDonough, F. E.; Hargrove, R. E.
Journal of Milk and Food Technology **35** (2) 102-106 (1972) [12 ref. En] [Dairy Products Lab., E. Marketing and Nutr. Res. Div., USDA, Washington, DC 20250, USA]

>50 FDA-approved chemical agents were screened for their suitability in cleaning-in-place systems for reverse osmosis/ ultrafiltration equipment, used for cheese whey concn. and fractionation, without causing damage to the membranes. Sanitation of grossly contaminated equipment was satisfactory using several agents, including iodophors (10 ppm available I), sodium metabisulphite (0.2%), diethylpyrocarbonate (0.05%), zephirin chloride (0.0006%) and calcium hypochlorite (10 ppm available Cl). The merits of each of these are discussed. Choice of agent depends on type and design of equipment, plant operated, allotted cleaning time and degree of microbiological control required. For best results, complete flooding of the equipment was necessary, indicating that sterilization cannot be assured unless the modules are mounted in a vertical position. SAC

10 P 1533
[Ultrafiltration and reverse osmosis for the treatment of whey on commercial scale.]

Horton, B. S., Goldsmith, R. L., Zall, R. R.
Revue Laitiere Francaise **1972** (298) 367, 369, 371-373, 375, 377 & 379 (1972) [Fr]
[illegible] discusses equipment for ultrafiltration and reverse osmosis treatment of cheese whevs on an industrial scale, mentioning the microbiological aspects and possible uses of the resulting concentrates. [See also FSTA (1972) **4** 5P664, (1971) **3** 6P866, & (1971) **3** 1P76.] SAC

10 P 1606
Whey desalination by electrodialysis.
Hoeting, W. A. G.
Food Technology in New Zealand **7** (3) 10-13 (1972) [En] [Werkspoor Water, Amsterdam, The Netherlands]

The development of whey desalinated by TNO (Netherlands Organization for Industrial Research) from triple-cell units to multi-cell electrodialysis units using anion- and cation-permeable membranes is described. An outline is given of cell pack sizes and electric current efficiencies for 8-h batch electrodialysis of 25% TS whey at <50°C. Capital and annual running costs are discussed. BEPC

11 P 1655
[Utilization of whey from the economic point of view.] Molkenverwertung aus ökonomischer Sicht.
Haisch, K. H.
Deutsche Molkerei-Zeitung **93** (27) 1082-1086 (1972) [18 ref. De] [Süddeutsche Versuchs- und Forschungsanstalt für Milchwirtschaft, Weihenstephan, German Federal Republic]

The concentration of the cheese industry in larger units has greatly limited the opportunities for disposing of whey by return to the suppliers and favoured instead its use as raw material for the production of dried whey, lactose, lactic acid, whey protein etc. in specialized factories. Economic utilization of whey for these purposes depends on a reduction of freight charges. This is usually accomplished by 5-fold concentration of the whey by evaporation at the cheese factory. Reverse osmosis, ultrafiltration and electrodialysis may, when developed, provide alternative methods of concentration. GTP

11 P 1687
New milk based products and processes.
Coton, S. G.
Food Processing Industry **40** (481) 51, 53 & 55 (1971) [En] [Milk Marketing Board, Thames Ditton, Surrey, UK]

A description is given of the Milk Marketing Board's research into ways of expanding the use of milk and dairy products in combination with other food materials. Aspects covered include: osmosis and ultrafiltration; concentration of milk; convenience snacks; and spray-dried products. VJG

11 P 1703
Evaluation of triticale silage for lactating cows.
Fisher, L. J.
Canadian Journal of Animal Science **52** (2) 373-376 (1972) [9 ref. En, fr] [Animal Res. Branch Agric. Inst. of Canada, Ottawa 4, Ontario]

The nutritive values of maize and triticale silage were compared in a changeover experiment using lactating Holstein-Friesian cows. Intake of silage DM was significantly greater ($P<0.05$) for maize silage (9.41 vs. 7.49 kg/100 $kg^{0.75}$ body wt.) than for triticale silage. Solids corrected milk yield, and protein content were significantly higher ($P<0.01$) for maize silage (25.0 vs. 21.4 kg/day and 3.34 vs. 3.11%) than for triticale silage. The apparent digestibility of DM for rations containing maize an triticale silage was 67.0 and 64.0%, respectively. AS

11 P 1718
Industrial processing with membranes. [A book]
Lacey, R. E.; Loeb, S. (Davis, T. A.; Brockman, G. F.; Huffman, E. L.; Ahlgren, R. M.; Nishiwaki, T.; Reid, C. E.; Lonsdale' H. K.; Merson, R. L.; Ginnette, L. F.) (Editors)
x+348pp. ISBN 0 471 51136 6 (1972)
[Numerous ref. En] Sussex, UK: John Wiley & Sons Ltd. [Southern Res. Inst., Birmingham, Alabama, USA] Price £7.35

The book provides engineers with theoretical and practical information for the design and operation of membrane processing plants. The book consists of 2 sections: Electrically driven membrane processes; and Pressure-driven membrane processes. The first section consists of: Basis of electromembrane processes, by R. E. Lacey (pp. 3-20, 27 ref.); Physicochemical aspects of electromembrane processes, by T. A. Davis and G. F. Brockman (pp. 21-37, 27 ref.); Engineering and economic considerations in electromembrane processing (pp. 39-55, by E. L. Huffman & R. E. Lacey (pp. 39-55, 14 ref.); Electromembrane processing of cheese whey, by R. M. Ahlgren (pp. 57-69); Electromembrane processes for recovery of constituents from pulping liquors, by R. M. Ahlgren (pp. 71-81, 5 ref.); and Concentration of electrolytes with an electromembrane process prior to evaporation, by T. Nishiwaki (pp. 83-106, 26 ref.); The second part contains the following chapters: Principles of reverse osmosis, by C. E. Reid (pp. 109-122, 10 ref.); Theory and practice of reverse osmosis and ultrafiltration, by H. K. Londsdale (pp. 123-178, 118 ref.); The costs of reverse osmosis, by R. E. Lacey (pp. 179-189, 7 ref.); Reverse osmosis in the food industry, by R. L. Merson & L. F. Ginnette (pp. 191-221, 52 ref.); JN

11 P 1719
Industrial processing with membranes. [A book]
Lacey, R. E.; Loeb, S. (Editors)
x+348pp. ISBN 0 471 51136 6 (1972)
[Numerous ref. En]

[Continued from preceding abstr.] Applications for reverse osmosis in the pulp and paper industry, by A. J. Wiley, A. C. F. Ammerlaan & G. A.

Dubey (pp. 223-247, 7 ref.); The treatment of industrial wastes by pressure-driven membrane processes, by R. W. Okey (pp. 249-277, 22 ref.); and Gas permeation processes, by S. A. Stern (pp. 279-339, 75 ref.). An 8-pp. subject index is included. JN

11 P 1768
Procesdings of the seventeenth Annual National Dairy and Food Engineering Conference.
[Conference proceedings]
Michigan State University
106pp. (1969) [En] East Lansing, Michigan, USA: Author

Papers read at this Conference in Feb. 1969 included the following: Accurate filling of ten-quart plastic containers, by W. J. Schieser (pp. 35-39); Returnable plastic container and detection, by R. L. Orsage (pp. 41-45); Costs and machine performance information of the blowmolded single service (disposable) milk container, by G. A. Pettersen (pp. 47-54); Rapid analysis for the organic carbon content and oxygen demand of waste water, by V. A. Stenger (pp. 63-66); An analyser for waste water, by J. Blank (pp. 67-68); Practical uses of whey, by G. A. Houran (pp. 69-74); Experiences with handling whey using reverse osmosis, by F. B. Leonard (pp. 75-82); Sanitary piping systems, by J. E. Beardsley (pp. 93-100); Sanitary aspects of conveyor lubrication, by W. J Ernst, Jr. (pp. 101-106). [See FSTA 4 7P975, 3 5P726 & 5P727 for subsequent conferences.] JMD

12 E 465
[Reverse osmosis and its application to foods and for production of drinking water.]
Aránа, E., R.
Tecnologia de Alimentos **7** (1) 6-11 (1972) [16 ref. Es]

12 H 1804
Fruit juice concentrates and powders: I. Development of a new concentration procedure. II. Physicochemical and volatile flavour changes.
Bolin, H. R.
Dissertation Abstracts International. Section B. The Sciences and Engineering 32 (7) 3996: Order no. 72-4703 (1972) [En] [Utah St. Univ., Logan, USA]

A diffusion-membrane procedure for the concn. of fruit juices is described. Evaluation of the effect various concn. methods had on volatile losses during the concn. of apple, sour cherry and peach juices showed that: freeze concn. resulted in the least loss; diffusion-membrane concn. resulted in a slightly greater overall loss of volatiles but less than osmosis, which was slow and resulted in a noticeable flavour change in both apple and cherry concentrates; and concn. by reverse osmosis was fairly fast and there was no detectable flavour change, but a large % of volatiles were lost. Microwave radiation seemed to accelerate water transfer through the membrane during osmotic concn. Juice powders lost a large amount of volatiles and the changes that occurred during drying could be detected in all juices by sensory evaluation. AA

12 L 957
Preservation of reverse osmosis membranes from microbial attack.
Kissinger, J. C.; Willits, C. O.
Food Technology **24** (4) 481-484 (1970) [6 ref. En] [USDA, E. Util. R&D Div., 600 East Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

A study was conducted to develop means to prevent microbial destruction of reverse osmosis membranes used in the concn. of maple sap. Addition of chemical germicides to the sap is not permissible since excessive concn. would result from the normal 40-fold concn. of sap. to syrup. Germicidal lamps, proven successful in sap storage problems, were used to treat the sap up-stream from the membrane modules to reduce the viable bacterial cell concn. to a low level. During periods when the equipment was idle, the membranes and pressure vessels were sanitized using a hypochlorite solution followed by a rinse with water which had been sterilized exposure to germicidal lamps. IFT

12 P 1793
Reverse osmosis - the anti-pollution system in milk and whey productions.
Nielsen, I. K.; Bundgaard, A. G.; Olsen, O. J.; Madsen, R. F.
DDMM Information **1972**: 6-11 (1972) [5 ref. En] [De Danske Sukkerfabrikker, DK 4900 Nakskov, Denmark]

The author deals with the DDS equipment (De Danske Sukkerfabrikker) which is comprised of modules. Standard modules are 20 cm in diam. and have membrane areas of 1.8 or 5.4 m^2 whilst those 40 cm in diam. have membrane areas of 7 or 28 m^2, some withstanding pressures of up to 100 atm. In the dairy industry it is preferable to arrange individual modules in parallel. In the treatment of whey with a BOD of ~50 000 mg O_2/l initially, it was possible to reduce the pollution by >99.5% by the use of the 2-stage process i.e. ultrafiltration and reverse osmosis. An example of analyses of retained concentrates and permeates is given for the 2 stages of the process using whey. Uses for products obtained by the treatment of whey and kim-milk are discussed. [See also FSTA (1971) 3 8P1309.] FL

12 P 1823
[Speical issue on the occasion of the 3rd International DLG Dairy Engineering Exhibition, held in Frankfurt during 8-12 September 1972.]
Sonderheft zur 3ten Internationalen DLG-Fachausstellung für Molkereitechnik 8.-12. September 1972, Frankfurt.
Anon.
Deutsche Molkerei-Zeitung **93** (35) 1395-1542

(1972) [Numerous ref. De]

This special issue includes the following articles: Automation in the dairy (pp. 1396-1404), Trends in the development of the dairy industry in Hessen, by R. Meissner (pp. 1405-1410), Dairies in Hessen seen from the technical and organizational point of view, by H. Güngerich (pp. 1415-1420), Tests for inhibitory substances in raw milk in respect of the assessment of its quality and payment, by H. Lupke (pp. 1421-1426), Present position and trends in milk packaging in Europe, by R. Heiss (pp. 1431-1436); Standardization of production processes in cheesemaking, by -. Prokopek & E. Voss (pp. 1437-1450, 13 ref.); Problems in the standardization of production processes in soft cheese factory, by K.-H. Haisch, A. Schebler & R. Schorr (pp. 1451-1453, 2 ref.); Mechanized production of rennet cheese and its suitability for processed cheese manufacture, by L. Eisenreich (pp. 1454-1458); Effect of the method, particularly UHT processing, on the consistency, emulsion stability and protein swelling capacity of processed cheese, by F. Kiermeier & G. Weiss (pp. 1461-1468); A dairy expert in Brasil - his 2-yr activities in Rio Grande do Sul, by E. Meiler (pp. 1471-1481); Critical observations of safety switches in the dairy industry, by W. Hensele (pp. 1482-1485); Manufacture of instant non-caking dried whey, by J. Pisecky (pp. 1486-1491, 2 ref.); Recovery of whey proteins and their uses in cheesemaking, by B. G. Haustein (pp. 1492-1499); Demineralization of milk and whey by the Morinaga method, by K.-H. Huwe (pp. 1500-1502); Reverse osmosis and ultrafiltration for the treatment of milk and whey, by D. Pepper & K. Marquardt (pp. 1504-1509). Review of equipment at the Exhibition is given on pp. 1510-1539. FL

12 P 1871

Restrictive product waste measures in dairy plants.

Werner, H.

DDMM Information **1972**: 3-5 (1972) [En] [Govt. Dairy Res. Inst., Hillerod, Denmark]

Measures that may be taken to reduce the spillage of milk and other liquid and semi-liquid milk products at each processing stage are outlined, and the processing of the recovered products by reverse osmosis and drying into feedstuffs is recommended. FL

12 P 1925

[Reverse osmosis plant for the concentration of whey.] Betriebsanlage für die Hyperfiltration (Umkehrosmose) zur Konzentrierung von Molke im Betrieb.

Madsen, R. F.

Nordeuropaeisk Mejeri-Tidsskrift **38** (8) 165-166 (1972) [Da & De] [A/S De Danske Sukkerfabrikker, Nakskov, Denmark]

A brief description is given of a reverse osmosis plant for concentrating 80 t whey to 20 t/day, put into operation in May 1972 in the cheese factory Val d'Or, in France. The plant consists of 2 sections, each comprising 5 DDS modules with a membrane area of 25 m^2/module. The whey concentration is carried out in 24-h batch operations, each being followed by passing water through the system to force out the whey concentrate from the modules into storage tanks. The cleaning procedure involves rinsing with water, followed by a detergent solution and water, sterilization with a hypochlorite solution and final rinsing with water. Once a week the system is cleaned with a trypsin solution. FL

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